



Technical Information Center Micrographics & Imaging Services

Introduction

Micrographics & Imaging Services (MICRO) and the Technical Information Center (TIC) at the Denver Service Center (DSC) began as the Branch of Micrographics for the Western Office of Design in San Francisco, California. TIC is the oldest centralized bibliographic information system in the National Park Service. After nearly 40 years of planning, developing, and refining a microfilm storage system and computerized information system, TIC has developed into a comprehensive information system that is both user friendly and cost-effective. TIC is designated by the Service as the central repository for managing all NPS-generated planning, design, and construction drawings, and related technical report documents. The source documents are scanned and microfilmed by MICRO for storage. TIC's bibliographic database lists and tracks the data and is expanding to include document images. TIC partners with MICRO to provide document delivery for each item in the database, a very important part of the process to the users. The information base is computerized for the manipulation and retrieval of bibliographic data, PDF files, and TIFF image files via the Intranet. TIC is capable of accessing the vast amount of technical information holdings of the Park Service, and of supplying details of available information, format, and location of the original.

Description of the Information

Planning, Resource Management, and Development Type Documents

These documents establish the guidelines for the overall use, preservation, management, and development of an area within the National Park System. They include the following:

Air Quality Studies	Legislative Support Data
Archeological Investigation Reports	Mining and Minerals Studies
Archeological Research Studies	National Natural Landmark Investigations
Archeological Salvage Studies	National Scenic Trail Studies
Concession Management Plans	Natural Resource Studies
Cultural Resource Preservation Guides	New Area Studies
Cultural Resource Studies	Outline of Planning Requirements
Development Concept Plans	Park Administrative Histories
Environmental Assessments	Pest Control Measures Used in Parks
Environmental Statements	Regional Plans
Environmental Studies	Research Permits
Fire Management Studies	Resource Aerial Photography
General Management Plans	Resource Base Information
Historic Furnishing Plans	Resource Case Protection Studies
Historic Resource Studies	Resource Management Plans
Interpretive Prospectuses / Plans	Resource Management & Assessment Profiles
Mining and Minerals Studies	Scientific Studies
Land Acquisition Maps / Studies	Special Resource Studies
Land Protection Plans	Statements for Management

Suitability / Feasibility Studies Transportation Studies Visitor Use Studies	Water Resources Studies Wild and Scenic River Studies Wilderness Studies
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The end products for this group of documents are usually in a technical report format, which may also include graphic products such as maps, plans, and drawings; these graphic products can also serve as a record of information by themselves. Report citations are recorded in TIC's database. Additionally source documents are scanned and saved as 16mm microfilm in microfiche format, graphic products which have NPS drawings numbers are also recorded in the computer and filmed in an aperture card format. TIC microfilm is an official NPS informational record.

Design and Construction Drawings and Related Documents

These drawings and documents are for the planning, development, and use of buildings and facilities in a particular park they may also include specifications and other design related documents. The drawings may be prepared either by NPS, or by a private professional office (A&E) for NPS; or by a professional staff hired by a concessionaire or another agency to prepare plans for construction of a new facility, or adding to, or repairs of an existing facility. In the latter case, the original drawing is the sole property of the concessionaire or the other agency, and not NPS; only prints are distributed to NPS offices, and they are processed according to the type of document, such as planning, design, or construction. In all cases a copy of this information is sent to DSC-TIC.

Design Documents	Construction Documents
<p>Documents that pertain to the design process usually consist of:</p> <ul style="list-style-type: none"> Bridge Studies Comprehensive Designs (report or drawing format) Construction Drawings (not proceeded by a preliminary drawing) DAB 5 year plan Design Analysis Design Presentation Drawings Environmental Assessments (design level) Environmental Statements (design level) Historic Structure Reports Preliminary Drawings Radio System Studies Road Studies Schematic Designs Site Aerial Photography Site Plans Topographic Drawings Trail Studies Utility Type Studies 	<p>Documents that pertain to the construction process usually consist of:</p> <ul style="list-style-type: none"> Amendment Drawings Construction Drawings (including those of historic structures) Furnishings and Equipment Drawings Modification Drawings Museum Exhibit Drawings** Radio System Drawings Shop Drawings* Space Assignment Drawings <p>*Shop drawings show in visual form the mechanical and/or other physical characteristics of the item installed, and the specifications explain these characteristics in detail. They are essential for the operation and servicing of these items.</p> <p>**Museum exhibit drawings are prepared by the Harpers Ferry Center and are distributed at the time of construction so that exhibit cases and other museum installations can be completed while the contractor is building the facility. These drawings should be cross-referenced to the set of construction drawings of the facility.</p>

Post-Construction Documents

These documents usually consist of:

- As-Constructed Drawings
- Historic Structure Preservation Guides
- Operation & Maintenance Guides

Note: Most design offices in the design development process prepare preliminary drawings that are converted after approval into working or construction drawings, and a duplicate copy of the preliminary drawing is put into TIC's files as a record copy. The duplicate record copy in DSC is a 35mm-microfilm aperture card; in other NPS offices that do not have microfilm equipment, it may be a Mylar duplicate or paper print.

The original preliminary drawings used in the set of construction drawings and may have more detailed information added to it. The same is true when preparing the as-constructed set of drawings. The construction drawing set is corrected to reflect modifications, amendments, shop drawings, and other final information depicting the way a facility or item was actually built. By following this procedure, the changes will always be made on the original set of drawings and not on a second or third generation reproduction.

The as-constructed drawings are the most important set of drawings in the design and construction process, as they represent a graphic record of the finished product. After construction is completed the as-constructed set is used for the maintenance and modification of the facility, and should be kept current and up to date.

Other Technical Documents

- Boundary Surveys
- Land Status Maps
- Monumenting Maps
- Right-of-Way Drawings

SEARCHING E-TIC

Every word, phrase, and number in the database is searchable as a keyword(s). Fields can be specified to narrow search results. The database was originally developed as a keypunch card system for the microfilm of engineering drawings mounted on aperture cards. This required the use of abbreviations in the database. A listing of the common codes used in the database is included. The use of **subject codes** and **location codes** to search the database is recommended to retrieve maximal results. The use of wildcard character % is also recommended.

Sample searches using wildcards are listed below:

Use % when searching for all items with the word visitor for Crater Lake NP, e.g.

Park Alfa: **CRLA**

Other text to search for in TITLE field: **%VISIT%**

Use % when you are not sure of the spelling, e.g.

Park Abbreviation: **CRLA**

Other text to search for in TITLE field: **%ROAD%**

There is no maximum set retrievable from the database. It is therefore necessary to carefully construct your queries to avoid long delays in retrieving information.

The FULL TEXT or DATA MINING search option can also be limited by using Boolean operators, NOT, AND, OR. Menu options are available under the Full Text Tab to help narrow search results.

Use NOT to exclude a term from a search, e.g.

Amphitheatre NOT Alaska

Use OR when you are searching for two or more topics e.g.

Campground OR Fee%

Use AND when you want to limit your search to site plans for any park, e.g.

Site Plans AND Transportation

How to Access the TIC

Access to the Technical Information Center (TIC) database is now available via the Internet. No dial up access is available. Using a Web browser type the following address:

<http://www.nps.gov/dsc/tic>

Then select **TIC** to access the database.

We would like to receive your comments about the database and the interface. Please send your comments to me, Jannette Wesley; I'll consolidate and turn them over to our programmer.

Jannette_Wesley@nps.gov

Technical Information Center

PO BOX 25287

Denver, CO 80225-0287

303-969-2131

ABBREVIATIONS AND CODES IN THE TIC

Status: Codes for Drawings, Reports & Aerial Photography

Drawings

ACD	As Constructed Drawing
CD	Concessionaire Drawings*
CP	Comprehensive Design*
DA	Developed Area (no longer used)
DEL	Delayed Project
DCP	Development Concept Plan (no longer used)
EA	Environmental Assessment (no longer used)
EIS	Environmental Impact Statement (no longer used)

LWR	Land Water Rights
MP	Master Plan or General Management Plan (no longer used)*
PD	Preliminary Drawing*
SM	Statement for Management (no longer used)
SS	Special Study (no longer used)
WD	Working or Construction Drawing*

The Status Code appears in the Status Column in the Revision section of each record in the database.

* If a “P” (e.g. PDP) follows status code, the drawing is “Pending Approval;”

** If followed by an “A” (e.g. PDA); the drawing is “Approved.” If the status code is not followed by a “P” or “A” the status could not be determined from the information given on the drawing.

Reports

AS	Alternative Studies (no longer used)
CM	Concession Management
CP	Comprehensive Design (no longer used)
DC	Development Concept*
EA	Environmental Assessment*
ES	Environmental Impact Statement or Environmental Statement*
HIS	History Studies (no longer used)
IP	Interpretive Prospectus / Plan*
LSD	Legislative Support Package

MP	Master Plan or General Management Plan*
NA	New Area Study*
PUB	Public Involvement Document
RM	Resource Management*
SM	Statement for Management*
SS	Special Study*
TS	Transportation Study
WR	Wilderness Recommendation
WS	Wilderness Study

* These status codes will be preceded by a “D” for a draft document (unapproved, e.g. DMP-draft general management plan) or “F” for a final document (approved, e.g. FMP-final general management plan).

Aerial Photography

The status code for aerial photography indicates what type of photography is available and whether TIC has film.

First column of status:

B – Black and white photography
 C – Color photography
 X – Black and white and color photography
 R – Infrared photography
 Blank – No prints on file

Second column of status:

C – Control prints on file
 Blank – No control prints available

Third column of status:

F – Film is on file
 Blank – No film on file

Disposition / Location Of Originals

<i>Blank</i>	Original is on file in Denver Service Center.
S	Original is on file in storage (Federal Records Center, Denver).
M	Location of the original is unknown.
A	Original is in the National Archives / obsolete.
N	Original in file is nonreproducible (sometimes in Reference Information as NON-REPRO).

T	Original is on file with the DSC team.
C	Original is on file at Chaco Center in Albuquerque, NM.
SC	Scanned.
SCM	Scanned and Microfilmed.
W	Original is on file in Washington.
R	Original is on file in the region.
H	Original is on file in Harpers Ferry Center.
P	Original is on file in the park.

Source Document Storage System

After bibliographic information has been input into the database, the source material is processed through a microfilm system for distribution and storage. There are two microfilm formats used in this process: the aperture card for maps, plans, and drawings, and microfiche for report documents. The formats capture the two major end products resulting from the planning, design, and construction process.

Aperture Cards

Maps, plans, and drawings are microfilmed by MICRO on a planetary camera using 35mm film. The film is then processed and mounted onto a card called an aperture card. The labeling information used on the aperture card is generated directly from the data entry record. Duplicate aperture cards are made and distributed to regional offices, as well as to those parks and field offices that have microfilm viewers. The microfilm aperture card process used by DSC is referred to as a Unitized Microfilm System, which means that the microfilm is used for more than just the storage of information. It is also used for the production of half-size prints to contractors, the parks, and the public for reference prints. The aperture card, when used in this manner, plays a major role in the day-to-day operation of managing this type of information.

Microfiche Format

Report-type (narrative) documents are scanned by MICRO using Kodak's Imagelink 500D or Kodak 3590C scanner and High-Volume Capture Software to TIFF Group IV image files. The image files are then converted by an independent contractor to 16mm film. The film is inserted into a microjacket with identifying information printed across the top. The microjackets are duplicated on 4"x6" film, which is called a microfiche. This process replaced the filming of the documents with the 16mm rotary camera in 1999.

The duplicate microfiche is distributed to various Washington offices and all regional offices, and to those parks and field offices that have microfiche viewing equipment. The microjacket contains five channels, each of which can hold up to 11 microfilmed pages of text; each jacket can hold up to 55 microfilmed pages. Because many of the reports and studies contain charts, maps, drawings, or other graphic products that are larger than a single page, some jackets may contain less than 55 pages.

Maps, drawings, or other graphic products that have NPS drawing numbers for identification are also microfilmed in aperture card format, and microfiche format, so they can be retrieved as a record of information by themselves.

Aerial Survey and Resource Photography

Aerial photography is also part of the computerized database. Color and black and white photographic negatives are stored in TIC for easy retrieval in reproduction of prints and print enlargements. In many cases, reference prints and aerial photo indexes are also maintained. Indexes are treated as maps and are numbered and filmed in the aperture card format. The original aerial film is not microfilmed.

Videotapes Photographs, etc.

TIC has a collection of planning, design, and construction-related videotapes and photographs.

Electronic Files

TIC has begun collecting the CADD files for engineering drawings, native files for the technical reports, e.g. Word and WordPerfect, PDF files and TIFF images from our scanning efforts. These files are being stored on CD-ROM's.

PRESERVATIONS STANDARDS AND PROCEDURES

Shipping Engineering and Architectural Drawings to MICRO & TIC

DSC recommends 3 day FedEx for the shipping of drawings to Denver for microfilming. Drawings can be shipped in FedEx map boxes, map tubes or commercially purchased map boxes. When shipped the drawings need to be rolled over a stiff cardboard tube to protect them from being crushed during shipment. Maps should be snugly packed to prevent damage from shifting during shipment. Maps transported in private vehicles or shipped to MICRO & TIC in large flat boxes need to be snugly packed to prevent shifting. Pack extra packing material, e.g., mat or foam core boards with drawings to make the map boxes more snug. Pack tissue drawings between two mat boards or foam core boards and secure with archival ribbon to prevent wrinkling and folding.

Turn-Around Time for Drawings Sent to DSC for Microfilming

Turn-around time for items sent to TIC vary. MICRO can microfilm 300 to 500 drawings per week. Drawing shipments under 100 sheets are usually filmed within 5 working days. Parks sending more than 100 drawing sheets at a time should schedule their shipments to ensure quick turn-around times.

Contact a TIC staff member, 303-969-2130, to ask about scheduling large drawing shipments for microfilming.

MICRO's Filming Specifications

MICRO's filming specifications are based on the size of the original drawing or document size. 29X lens reduction is used to film the standard size engineering or architectural drawing, up to 36"x50" or 'E' size. A standard microfilm printer with a 14.5X lens magnification produces accurate half-size reproductions of the microfilmed drawings at an enlargement ratio of 14:5.

Drawings 12"x18" or 11"x17", 'A' & 'B' sizes, are filmed at a reduction ratio of 14.5X diameter for a 1 to 1 print on a microfilm printer.

Drawings larger than 'E' size are filmed in parts or segments at 29X diameter and labeled in order, e.g., sheet 1A, sheet 1B, sheet 1C, etc.

The microfilm camera has a vacuum frame type system which flattens drawings that are curled and produces a high resolution across the image of the microfilm. MICRO uses 35mm roll negative, high-resolution polyester base film with a thickness of 0.125mm or 5 mills. This meets ISO standards for microfilming. Each exposed microfilm frame is mounted on an aperture card that meets military specification MIL-C-987713.

Polysulfide toning and color filming are not used.

Filming Standards

MICRO uses military specifications 9868b and AIIM/ANSI standards for filming engineering drawings. ANSI Standards MS-32, MS-23, MS-49 and 36 CFR 1230 have also been adopted.

Inspection and Quality Control Procedures

MICRO performs random testing of the microfilm cameras to ensure that the cameras meet or exceed specifications for resolving line resolution at a selected filming diameter or reduction ratio and balance light spread across the copy board. A contractor routinely performs the methylene blue test every year. It is performed again after a change occurs in the processing of the microfilm, manufacture chemical change, and film or equipment change.

Densitometric tests are performed daily with each roll of film to insure that the background density, image clarity and readability meet standards and are capable of being scanned into a digital format. Each processed microfilm frame is visually checked for BASE fog, camera and processor scratches, and image sharpness/alignment and correct indexing data to match the microfilm frame before mounting on aperture card.

Microfilming Costs and Charge Back Fees

The MICRO & TIC encourage parks to submit their drawings for microfilming as they are completed on a regular basis. Drawings are microfilmed without charge when we receive routine shipments. MICRO does charge to microfilm drawing collections retrospectively. The cost includes shipping originals to DSC, one master silver halide microfilm of each drawing sheet, scanning (when requested) of the microfilm or original drawing sheets, and the cost of the CD ROM's that hold the digital images. TIC staff are available to inventory and pack drawings for shipment from park offices to DSC for microfilming and indexing. The park covers travel costs.

As of October 2002, the cost for each silver halide microfilm master is 55¢. Costs are subject to change based on manufacturer prices for the microfilm. MICRO also produces master microfilm copies for the Technical Information Center, the park's regional office, and the National Archives and Records Center. The park does not pay for these three additional microfilm masters. The cost per image to scan the microfilm is 55¢ per image. CD-ROM masters are \$5 each. DSC pays return shipment costs for drawings that Parks choose to have returned to them for local storage. Parks wishing to receive duplicate copies of microfilm from MICRO can have these made for 30¢ each. The diazo dupe microfilm is used for copies. MICRO also charges for one microfilm master of each drawing sheet when DSC's contracting office handles the construction project work. Contact DSC, Micrographics & Imaging Services for current pricing information, 303-969-2030.

Models and Manuals

DSC generally follows best practices established by government and industry professionals. The TIC follows records management guidelines as outlined in Mary F. Robek, Gerald F. Brown, and David O. Stephens, 1996, 4th ed., *Information and records management: document-based information systems*, published in New York, NY, by Glencoe, McGraw-Hill, 600p. The publication "Managing cartographic and architectural records," by the National Archives and Records Administration, published in Washington, DC, in 1989, 38p., has also served as a model for TIC. TIC also uses manufacturer recommended storage and care guidelines, e.g., Paul L. Gordon, ed., 1983, *The book of film care*, published in Rochester, NY, by the Eastman Kodak Company. Scanning procedures are established by working with manufacturing representatives of each scanner. Scanning resolutions are calculated and tested using Anne R. Kenny and Stephen Chapman's, 1996, *Digital imaging for libraries and archives*, published in Ithaca, NY, by Cornell University Library.

Ensuring Microfilm Lasts Beyond 50 Years

The oldest microfilm in the TIC collection is 30 years old. A plan for re-filming the collection is under development. Microfilm masters stored in TIC are tested by our staff annually for stability using A-D Strips to test for the presence of vinegar syndrome in the film, an indication that the image needs to be re-filmed.

Storage of Engineering Drawings and Microfilm Masters

The engineering drawings and microfilm masters are stored at temperatures between 65° and 72° Fahrenheit. Microfilm is stored in cabinets and drawings are stored in large map drawers to protect them from dust and light. TIC stores a large number of the drawings off-site at the Federal Records Center in Denver. The National Archives and Records Center in College Park, MD, stores an additional set of microfilm masters for NPS. Regional Offices and some parks also have microfilm masters of the drawings pertaining to their administrative responsibilities.

Indexing the Microfilm Masters

Every item in the TIC collection including microfilm masters is listed in the TIC database. The database is currently available on the Internet at the following address: <http://www.nps.gov/dsc/tic>. Currently they are not listed in the National Registry of Microfilm Masters.

Procedures for Parks to follow for DSC to Microfilm their Architectural Drawings

Parks that routinely send their drawings in for filming should enclose a note with each shipment directing TIC to keep or to return the enclosed drawings after filming. Since there is no charge for microfilming routine shipments of drawing sets, nothing else is required.

Parks with a large backlog of drawings needing microfilming can call TIC to estimate the cost of a microfilming and/or scanning project. A site visit can also be arranged by TIC to provide a more accurate estimate to the park. DSC needs written authorization to proceed for amounts over \$2500; e-mail is acceptable. Project agreements clearly outlining the scope and costs of the project are also prepared for big projects.

How the MICRO and TIC Developed

In 1963, a study was conducted to analyze the feasibility of installing a microfilm system in the Western Office of Design and Construction. It was believed that such a system might help solve some of the major problems that were occurring in all design offices, such as the increasing costs of preparing, filing, and retrieving technical drawing information, as well as the reproduction and distribution of these documents. The study indicated that military as well as private design offices had solved many of the basic problems by using microfilm techniques, which resulted in saving space, manpower, and money.

The National Park Service (NPS) and the Department of the Interior approved the study recommendations in June 1964. A pilot installation began operation in January 1965 in the Western Office of Design and Construction in San Francisco.

At first, the system was used to film drawings for the review and approval process. In place of transmitting full-size drawings throughout the country, microfilm aperture cards were used and distributed to the Washington (WASO) and regional offices, and half-size prints were distributed to the parks.

In addition to the review and approval process, the system was used to quickly prepare multiple half-size prints of construction drawings bid sets for distribution to contractors.

Computerized Data Base

During 1965 to 1966, it became apparent that the microfilm system had to be supplemented with an automatic data processing system to manage the large amount of information. A successful microfilm storage system requires a method for rapidly and accurately locating and retrieving information, and it was determined that a computer system that identifies, classifies, and codes information for storage and retrieval would meet this requirement. The keypunch card became the basic input document for entry to the computerized database. However, to make the information capable of being processed manually, as well as by machine, the card format was designed to contain printed information as well as machine-readable information. The computer was then programmed to store, arrange, and retrieve using printouts of the drawing information in a manner that was most useful to the client.

Initially, the information system contained only "bibliographic" data for drawings and maps of those areas administered by the Western Office of Design and Construction. The data consisted of citations to master plans, topographic maps, designs, and construction drawings. In 1968, the system was expanded to include resource and site aerial photography used by the planning and design office as well as the parks, regions, and Washington offices.

In 1972, the system underwent two major changes. First, the Eastern and Western Service Centers were combined into the Denver Service Center (DSC), and the system was expanded to cover all areas of the national park system. The second change brought narrative, report-type documents into the system. Traditionally, park master plans had been in a drawing format; however, in 1967, this format was changed to a report format. As a result, the system was expanded to include this information as well as other report-type documents generated by DSC.

In 1975, the system was again expanded to include all types of technical report documents used for the planning and design process, not only those generated by DSC, but also those generated by the parks, regions, and Washington offices.

Between 1979-1989, TIC was maintained on the Boeing computer using the INQUIRE DBMS. Key punch data entry cards became a thing of the past. These were years of huge growth and a redefinition of TIC's role in the National Park Service. During this time, TIC became a service-wide repository for all disciplines of drawings, maps, and documents; large acquisitions of non-NPS information for acquired areas were cataloged, microfilmed, and added to the database. TIC also strengthened its role in responding to public requests for NPS technical information.

In April 1990, a minicomputer system was installed in TIC. The custom-designed INFORMIX database was maintained on a SUN workstation to allow access for four DEC terminals for TIC staff. The database was designed as a document management system to allow different versions of drawings and documents, etc., to be stored in the same bibliographic record. This system allowed TIC staff to directly access data in the system, and to run reports and download them to a PC/ASCII WordPerfect file or a comma-delimited file.

The popularity of the Internet and Wide Area Networks prompted the TIC to convert their database to a Web, deliverable product in 1998. The database was loaded on a Lotus Notes Domino Web Server and is now available at the following URL:

https://165.83.20.55/Amoeba/TIC/TIC.NSF/TIC_DBSearch_Intranet?OpenForm&Seq=1

In May of 2003 TIC again moved its database platform to a document management system that allows TIC staff to easily match metadata with scanned images and native electronic files. Currently over 300,000 images are available in this database for viewing. TIC plans to roll the E-TIC document management system out to the NPS Intranet during the Spring of 2004.

Today, the system holds over 200,000 , metadata records, which represent 1,000,000 microfilm aperture cards of maps, plans, and drawings; 1,500 records of resource and site aerial photography; and 85,000 planning, design, construction, natural resource, and cultural resource documents. Some sample images of the documents in TIC are currently being added to the database for each park. Lotus Notes software used by TIC will eventually allow park units to send their documents electronically to the TIC and enter descriptive information for each item submitted.

TIC is currently defining easy-to-use screens for lay-users of the database, researching imaging systems that utilize advanced storage technologies, and exploring the integration of CAD and archival images. Because TIC is an archive as well as an information system, the questions being asked are complicated and long-term.